# Comparison of the crust and upper mantle structure of the Alboran and Algerian domains (Western Mediterranean): Tectonic significance



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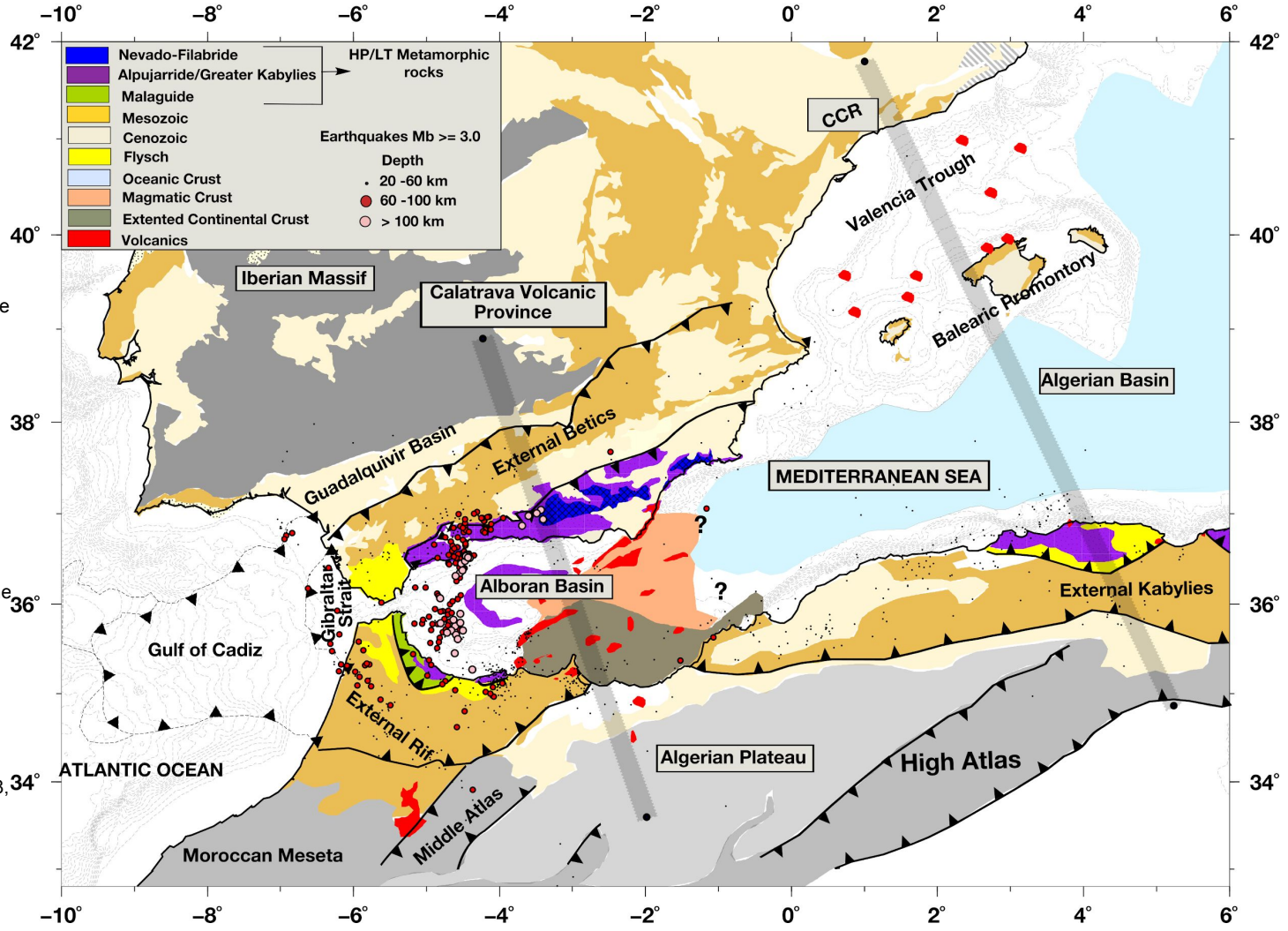
SUBITOP

HORIZON 2020

MARIE CURIE ACTIONS

# What?

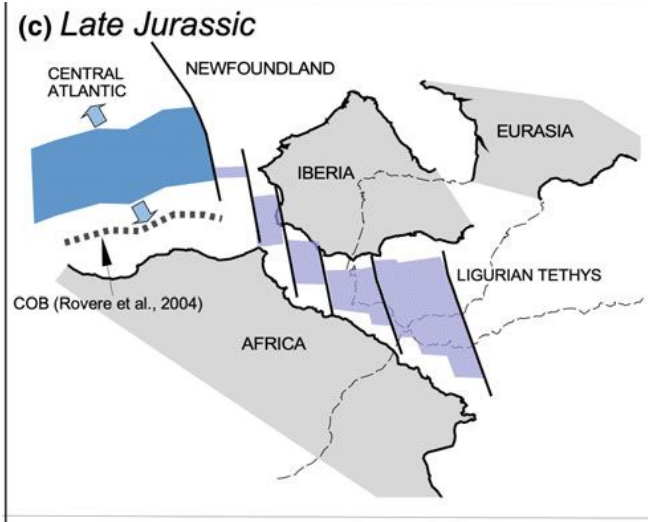
- HP/LT Metamorphic rocks
- Back-arc basins
- Volcanism
  - Orogenic
    **Valencia Trough**
    Early Miocene-Middle Miocene
    Calc-alkaline (Martí et al. 1992)
    **Alboran Basin**
    Si-K-rich (Upper Miocene-Lower Pliocene) (Duggen et al. 2004)
  - Anorogenic
    **Valencia Trough**
    Middle Miocene- recent
    Alkaline
    **Alboran Basin**
    Si-poor,Na-rich Upper-Miocene - Pleistocene

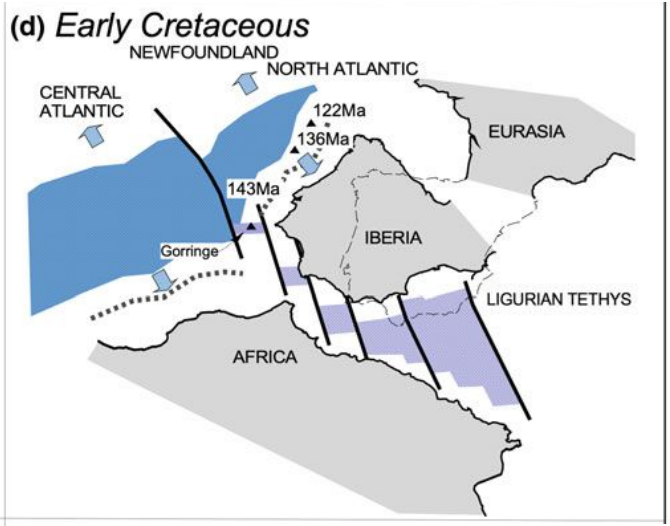


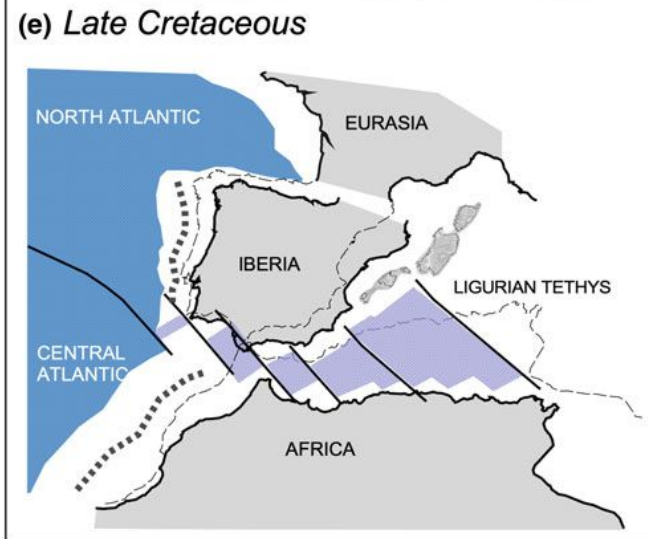

Vergés & Fernàndez, 2012, Pena et al. 2018, Firozen de Lamotte et al. 2011, Martí et al. 1992, Duggen et al. 2004,2005,2008

# What?

Trans-tensive and **highly extended continental segments transition to oceanic lithosphere** to the east.



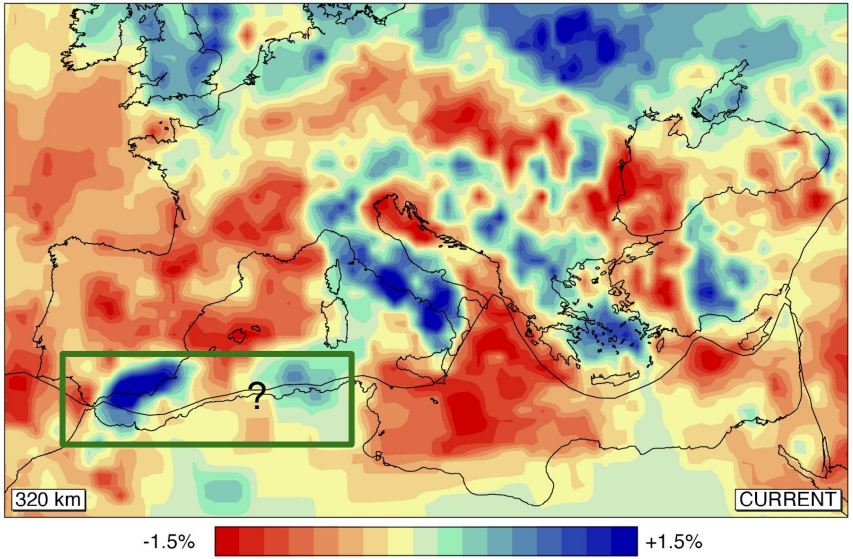




Stampfli & Borel 2002; Schettino & Turco 2011; Nirrengarten et al. 2018; Vergés et al. 2019

# What?

## Alboran Slab

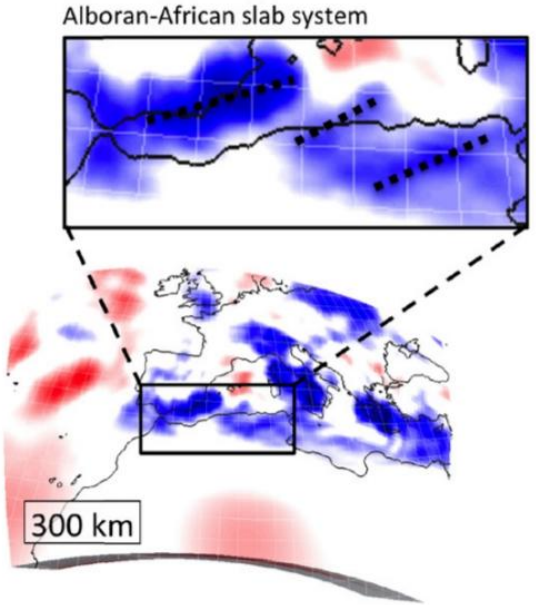
Travel time inversion




*Villaseñor, Spakman and Engdahl, 2003*

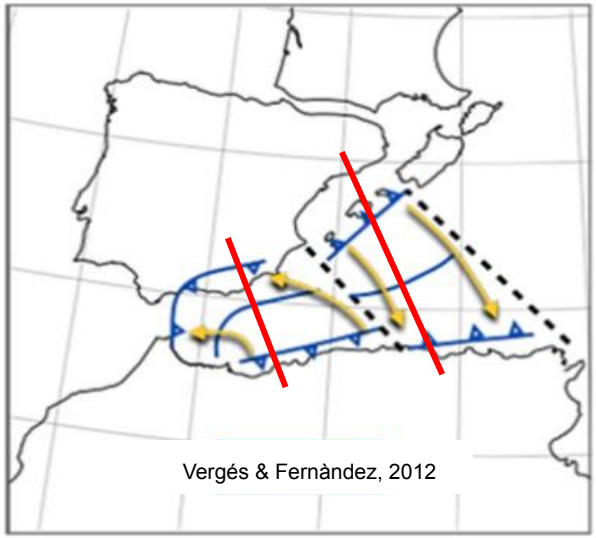
## Algerian Slab

Full waveform inversion



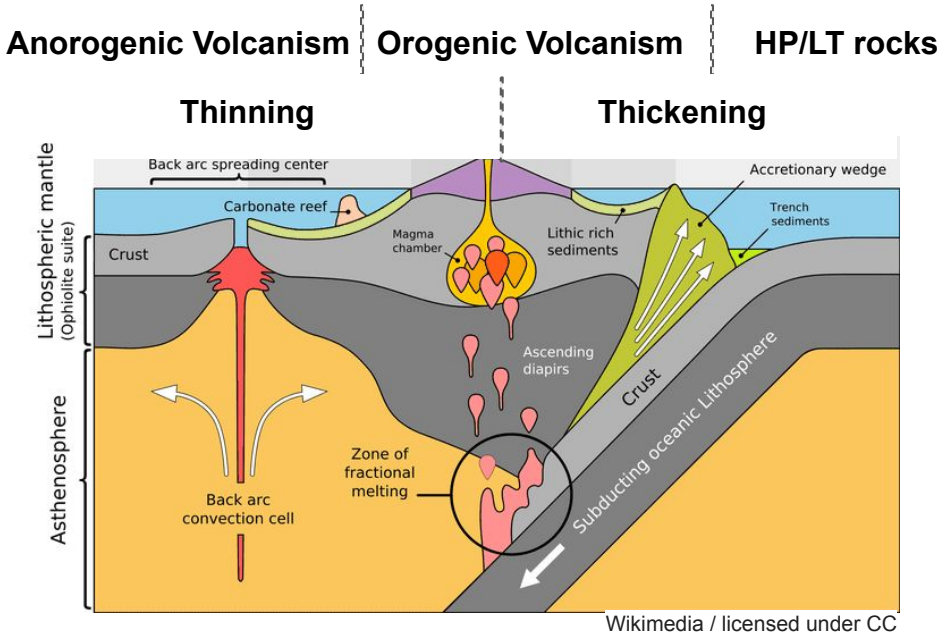

*Fichtner and Villaseñor, 2015*

# Why?



Vergés & Fernàndez, 2012

# Typical subduction

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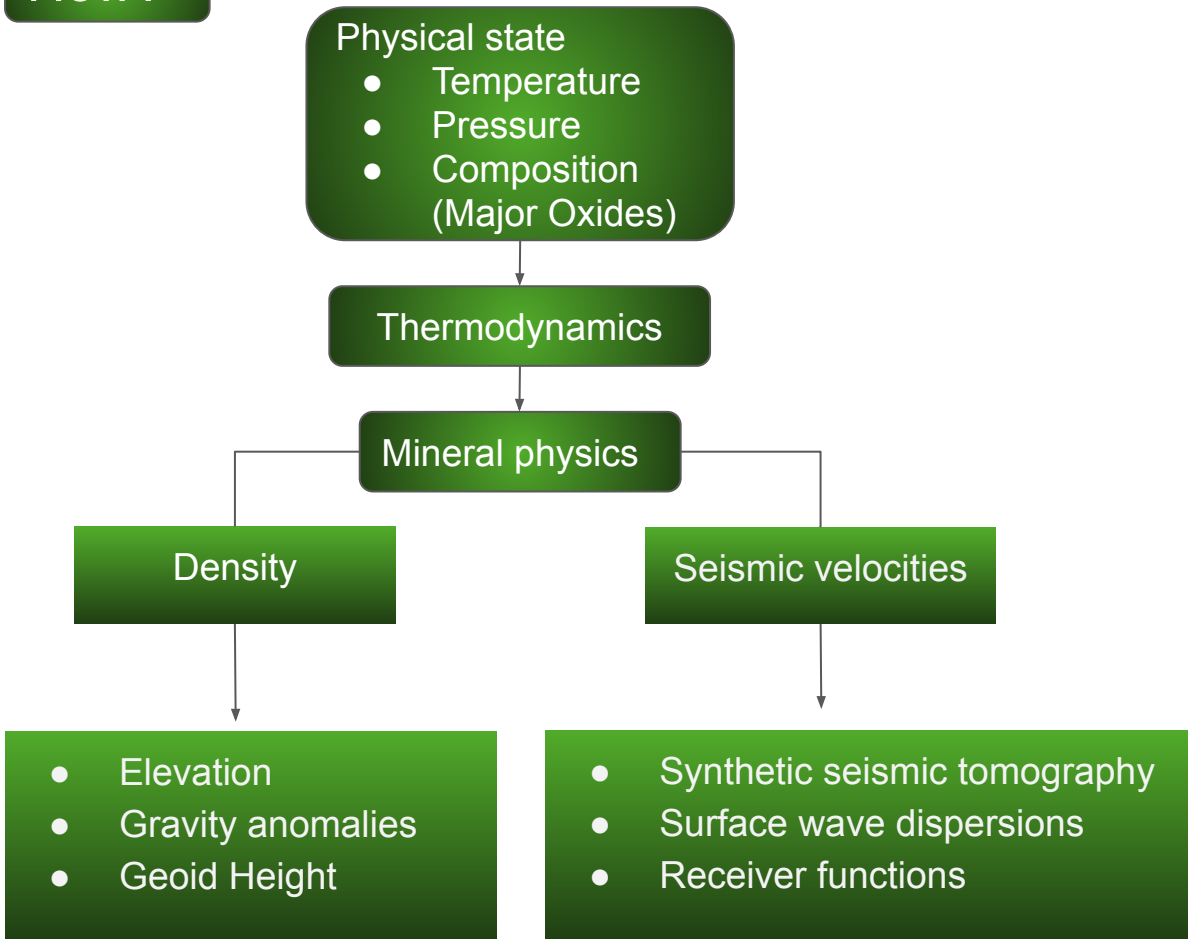
Can the opposite polarity subduction model explain the present day crust and upper mantle structure in the Alboran and Algerian basin?

# How?



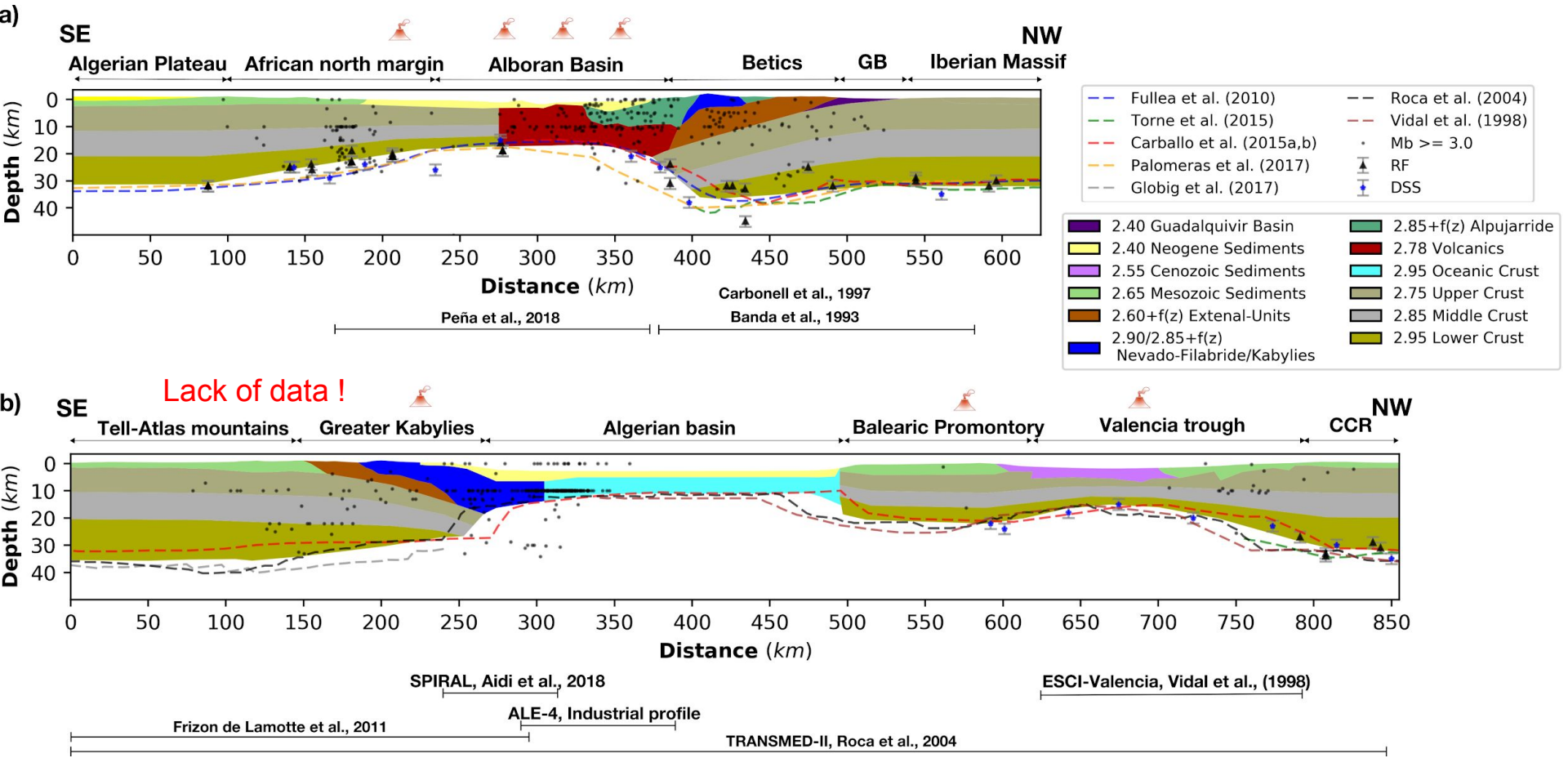

# LitMod2D_2.0

GitHub

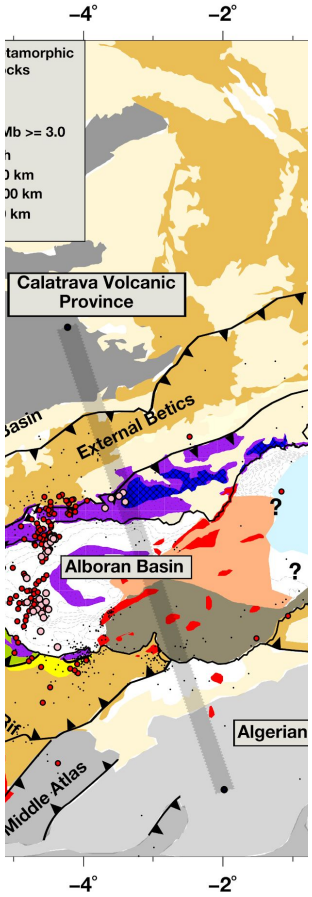
- Improved from LitMod2D_1.0 (Afonso et al., 2008)
- Depleted mid oceanic ridge basalt mantle (DMM, *Workman and Hart, 2015*) in the sublithospheric mantle
- Anomalies in sublithospheric mantle
  - Thermal
  - Compositional
  - Seismic velocities
- Anelastic attenuation parameters from recent laboratory measurements

*Kumar et al. 2020*

# Crustal scale model



# Alboran

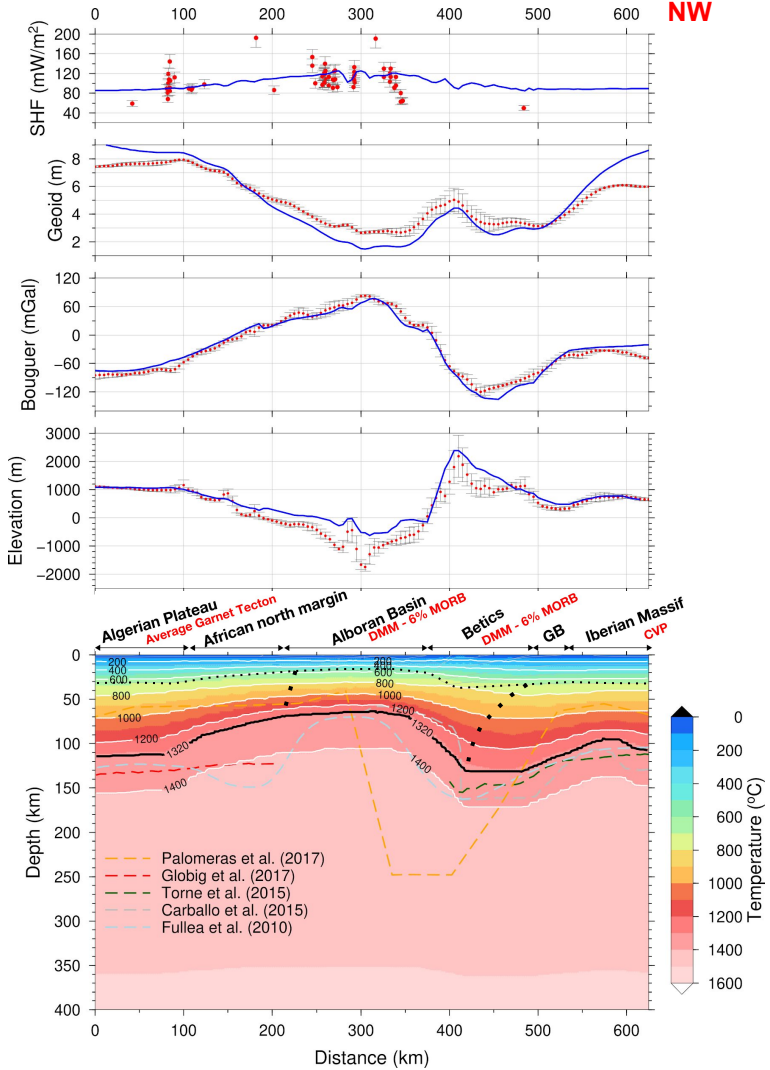


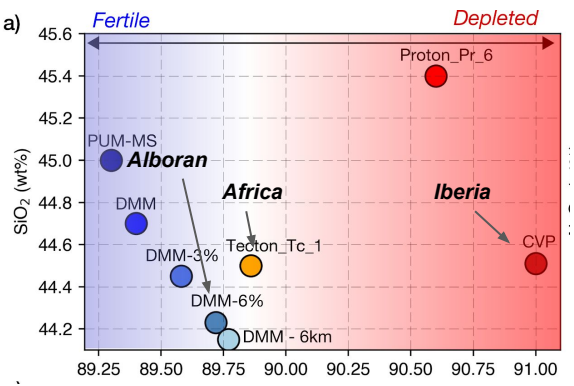

SHF

Geoid

Bouguer

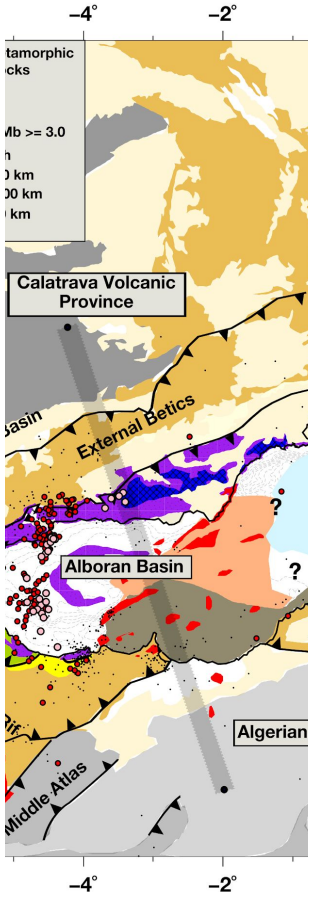
Elevation




Mass deficit beneath Betics.
Slab?

# Alboran

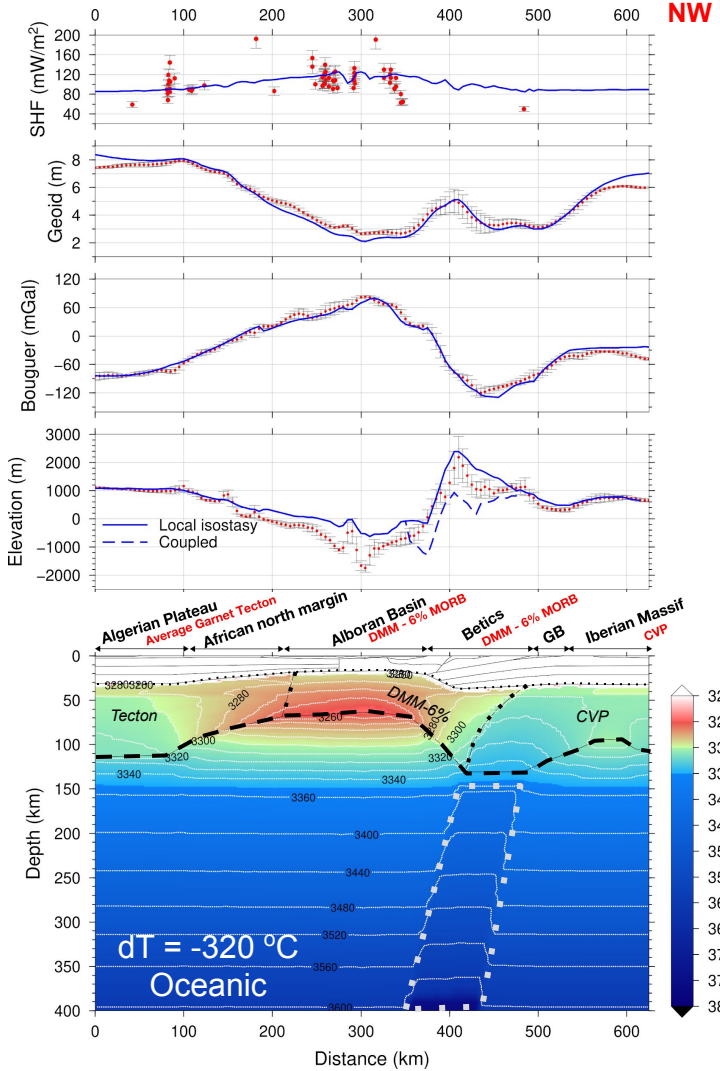


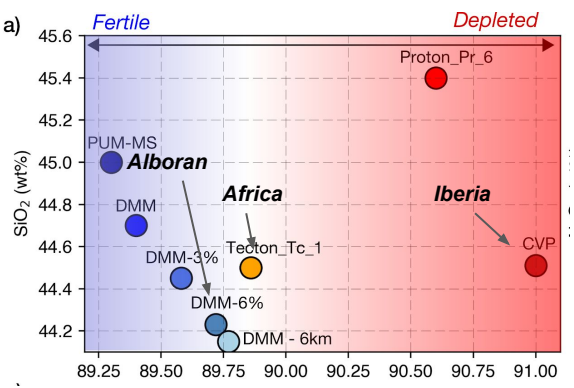

SHF

Geoid

Bouguer

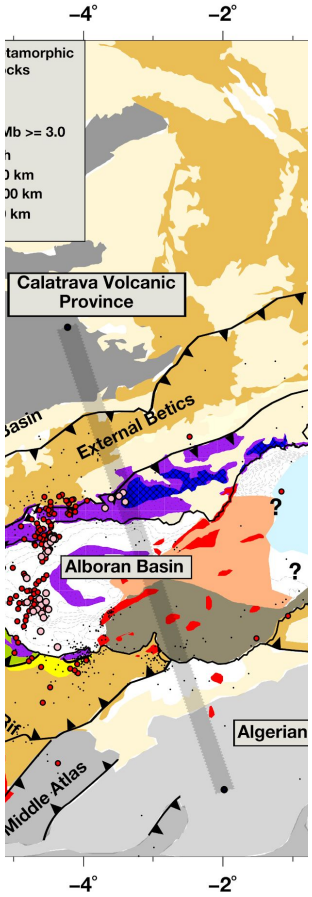
Elevation




Oceanic slab still not enough.

# Alboran



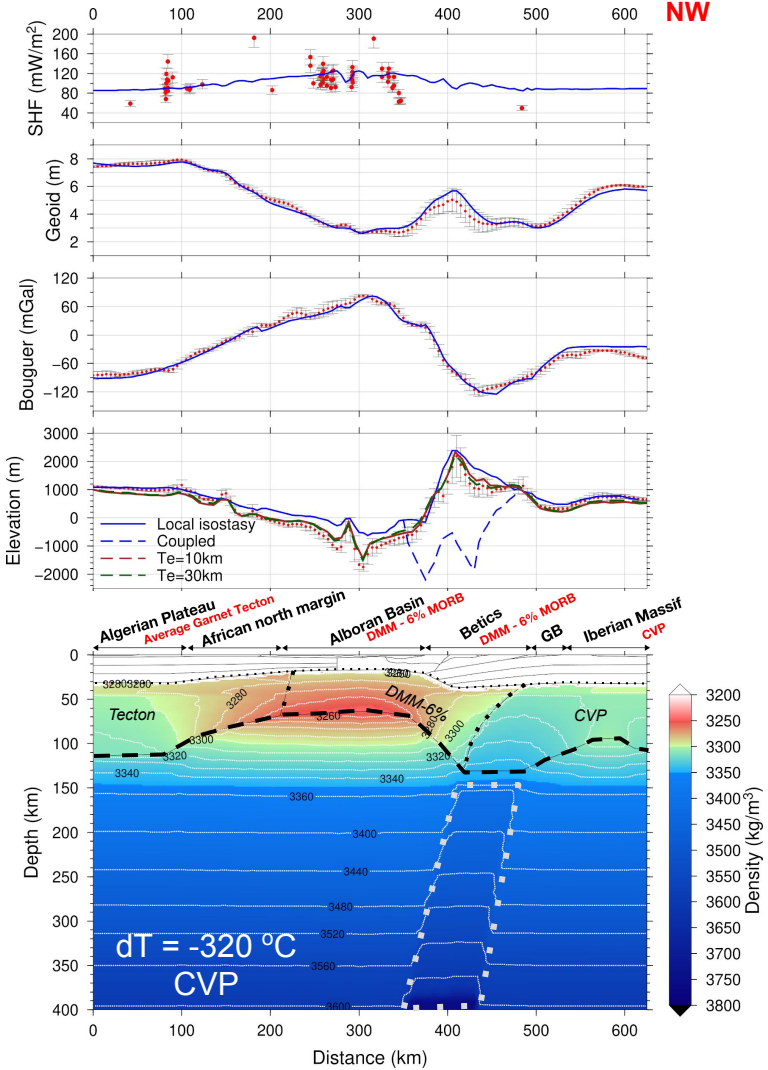

SE NW

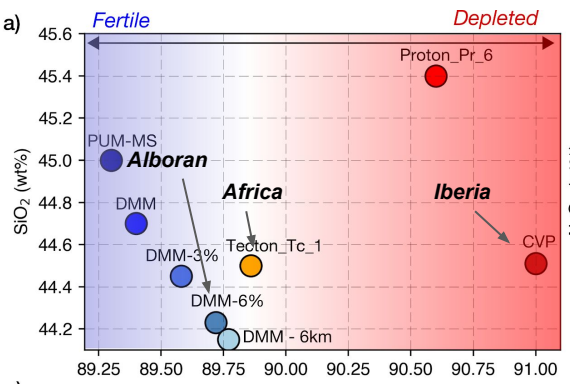
SHF

Geoid

Bouguer

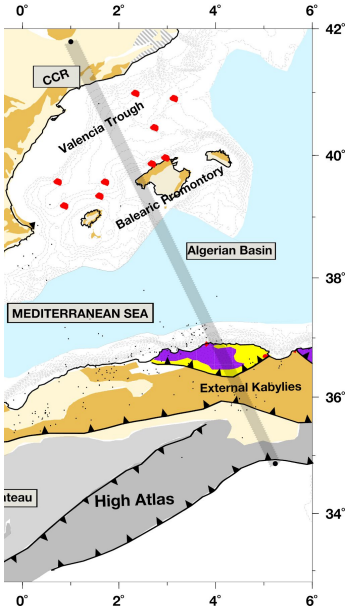
Elevation




Slab with same composition as Iberian lithosphere.

# Algerian



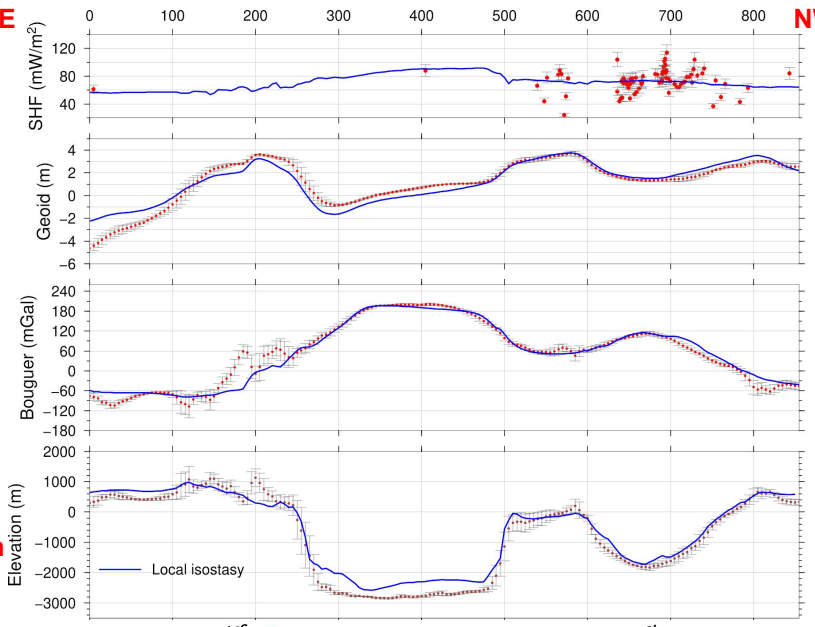

SE NW

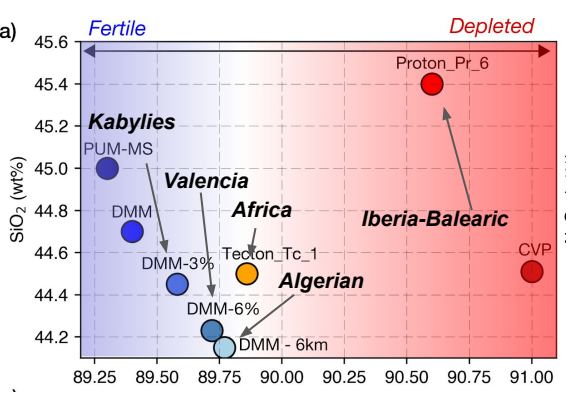
SHF

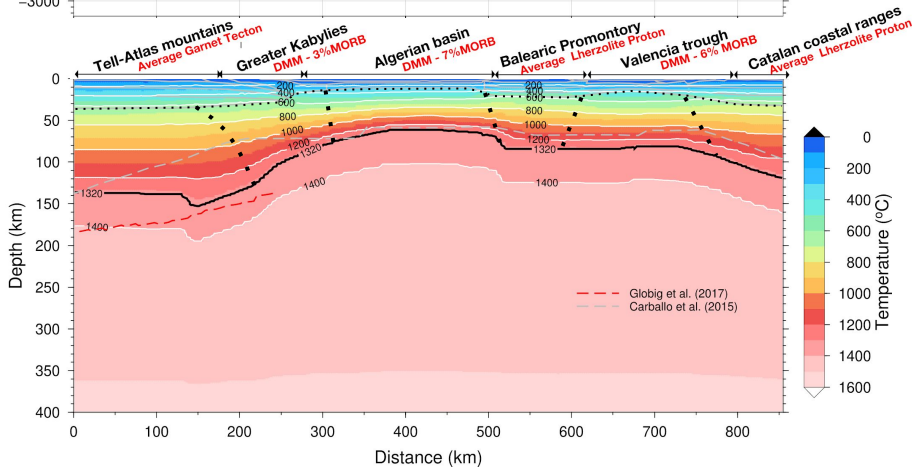
Geoid

Bouguer

Elevation

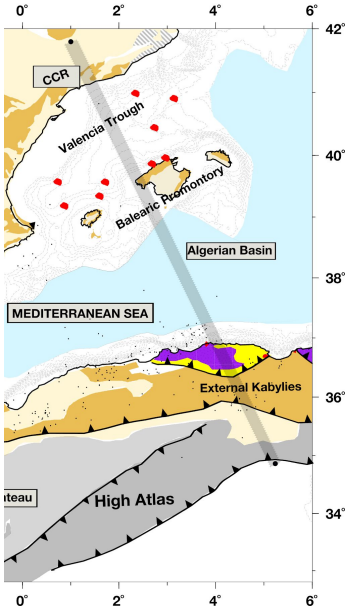


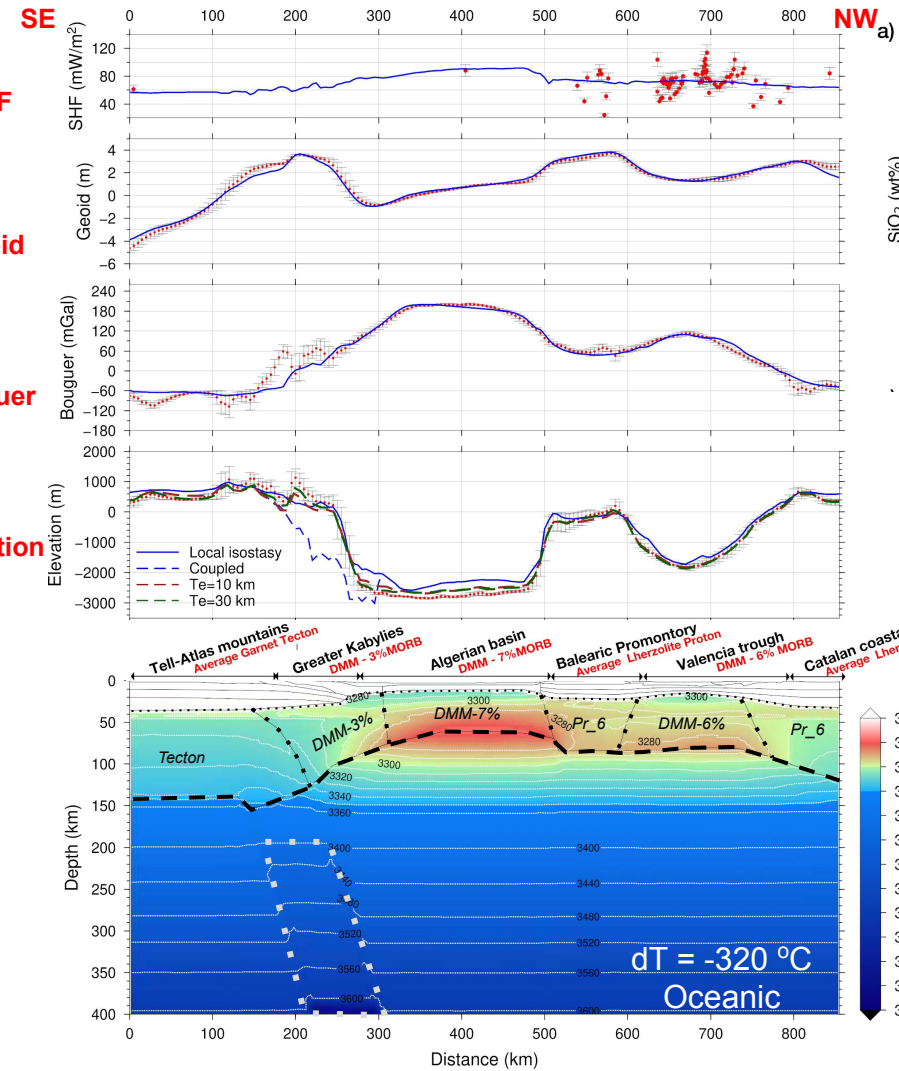



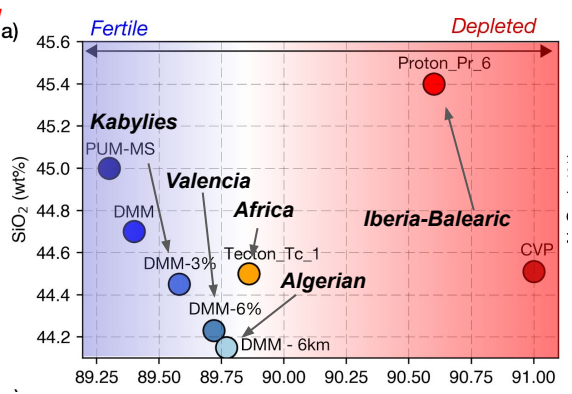




Mass deficit beneath Kabylies.

# Algerian



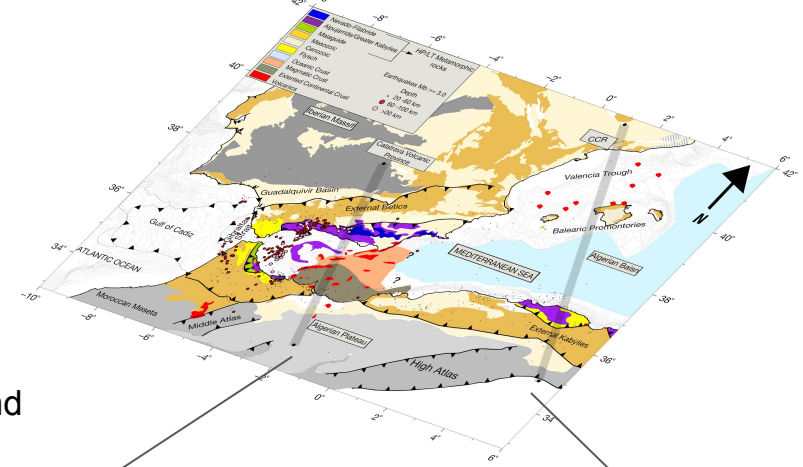



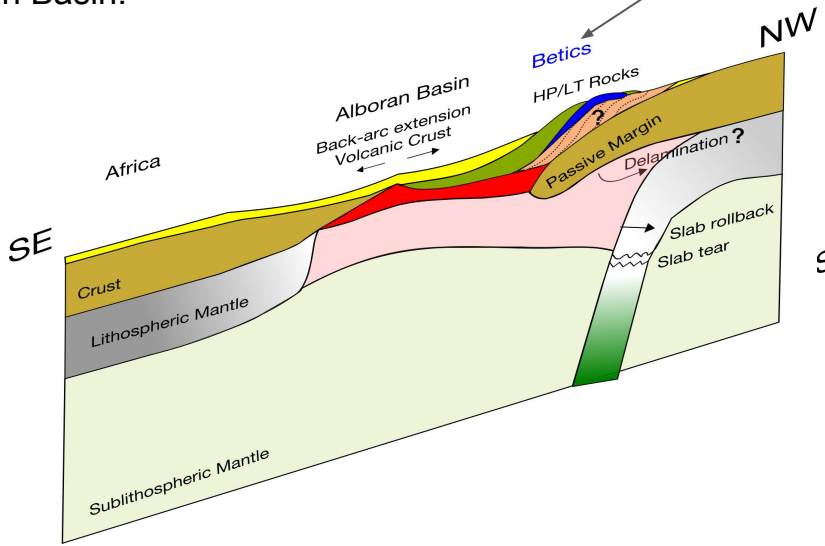



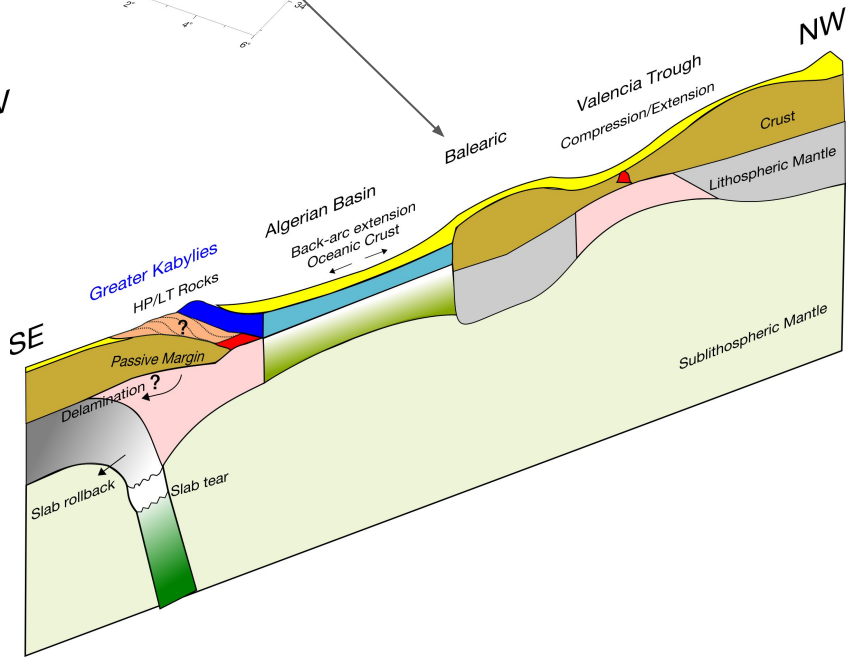

Slab with oceanic lithosphere composition fits better.

# Summary

- Thick lithospheres on opposite sides.
- The Alboran slab is less fertile than the Algerian slab.
- Relatively fertile mantle beneath Alboran and Algerian Basin.



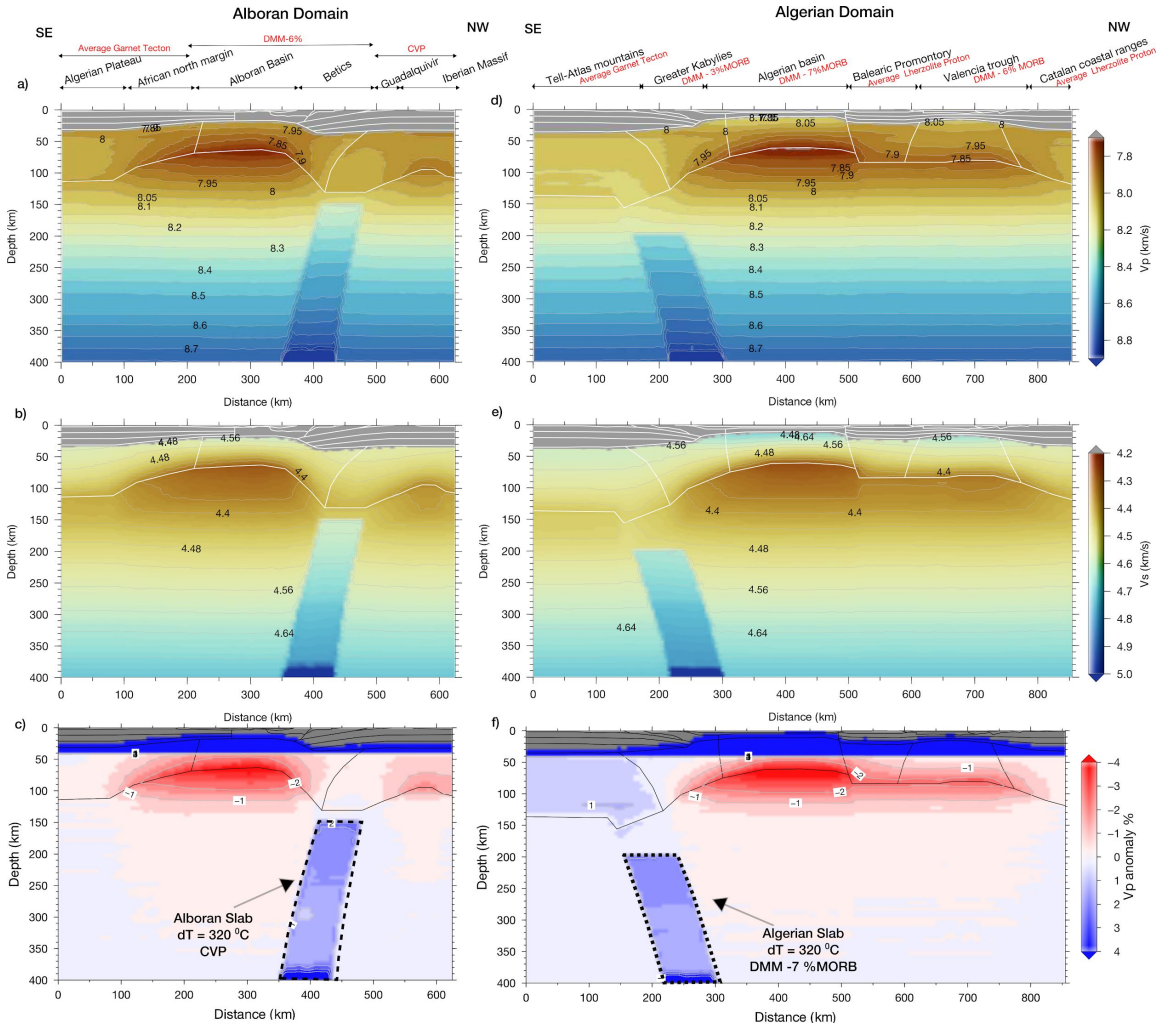




Schematic illustration, not to scale!

# Supplementary slides

# Seismic velocities



# Lithospheric Mantle : Chemical composition

PUM - **P**rimitive **U**pper **M**antle

(McDonough & Sun 1995)

DMM - **D**epleted **M**id-oceanic-basalt **M**antle

(Workman & Hart 2005)

Tecton_Tc_1 - Average Garnet **T**ecton

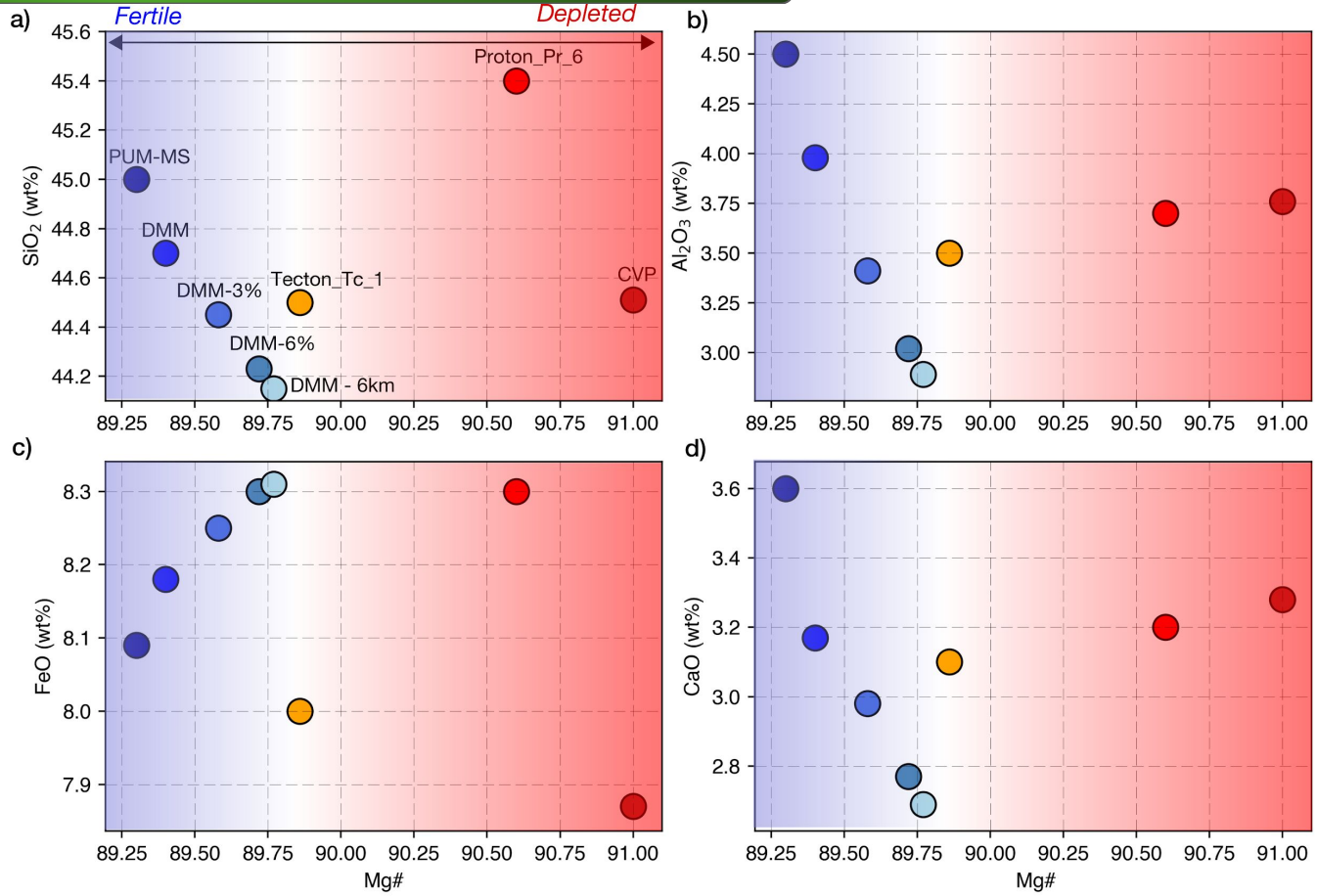
(Griffin et al, 2009)

Proton_Pr_6 - Average **P**roton Lherzolite

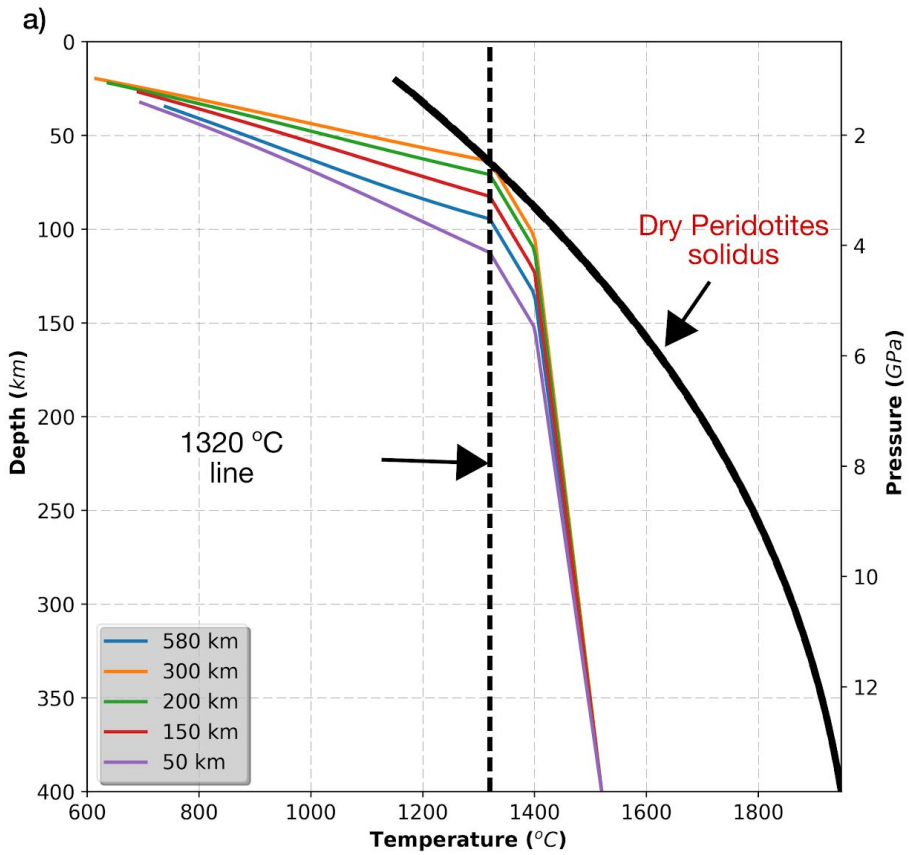
(Griffin et al, 2009)

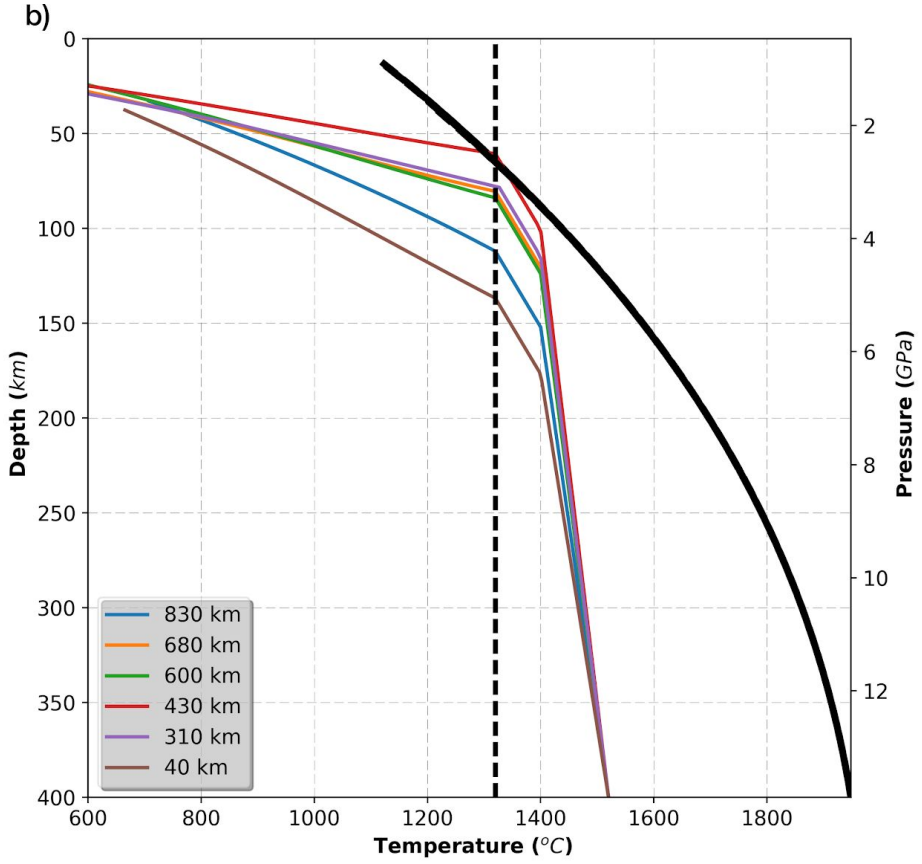
CVP - **C**alatrava **V**olcanic **P**rovince

(Villaseca et al. 2010)



# Melting


a)
Dry Peridotites solidus
1320 °C line
580 km
300 km
200 km
150 km
50 km
Depth (km)
Pressure (GPa)
Temperature (°C)


b)
830 km
680 km
600 km
430 km
310 km
40 km
Depth (km)
Pressure (GPa)
Temperature (°C)